The Use of Models in an Oil Spill NRDA Context

Ralph K. Markarian, Ph.D.

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ENTRIX
ENVIRONMENTAL CONSULTANTS

Transport, Fate and Effects ("TFE")

What and Why of Models

Oil Spills Are Messy

Cooperative NRDAs and TFE Models

- Models can serve as a platform for discussion, collaboration and resolution/settlement
- But….there are challenges

Spills are Messy in More than One Way: Injury Estimation is Challenging

- Potential injuries difficult to observe
  - Exposure of ichthyoplankton, benthos, fish
  - Exposure of offshore waterbirds
- Ephemeral data not systematically collected
  - Impacted areas inaccessible or situation to dynamic
  - Collection methods were not systematic
- Under these conditions Transport Fate and Effects (TFE) modeling may be appropriate

TFE Modeling in NRDA: The Challenge

- TFE modeling is
  - ✓ Relatively complex
    - Numerous input parameters, assumptions, model "set-ups"
  - ✓ Not transparent/accessible to most NRDA participants
    - Requires knowledge of, and access to, potentially proprietary computer code
  - ✓ Challenging to verify due to data sparsity
- As such, TFE modeling requires heightened collaboration and a focus on transparency

Aquatic TFE Models

Basically, Two Models Currently Used in Injury Determination

- COSIM – ENTRIX/ERM
- SIMAP – ASA, INC.

What do they provide?

- Transport of surface oil
- Fate of oil – air, water, sediments shoreline
- Injury estimates for aquatic life
- Use in wildlife assessments (birds)

COSIM - B 120 example


May? 2003


H 215 12/22/05
2912.3201,N,09329.4616,W,193008,A 01:31
48Ft
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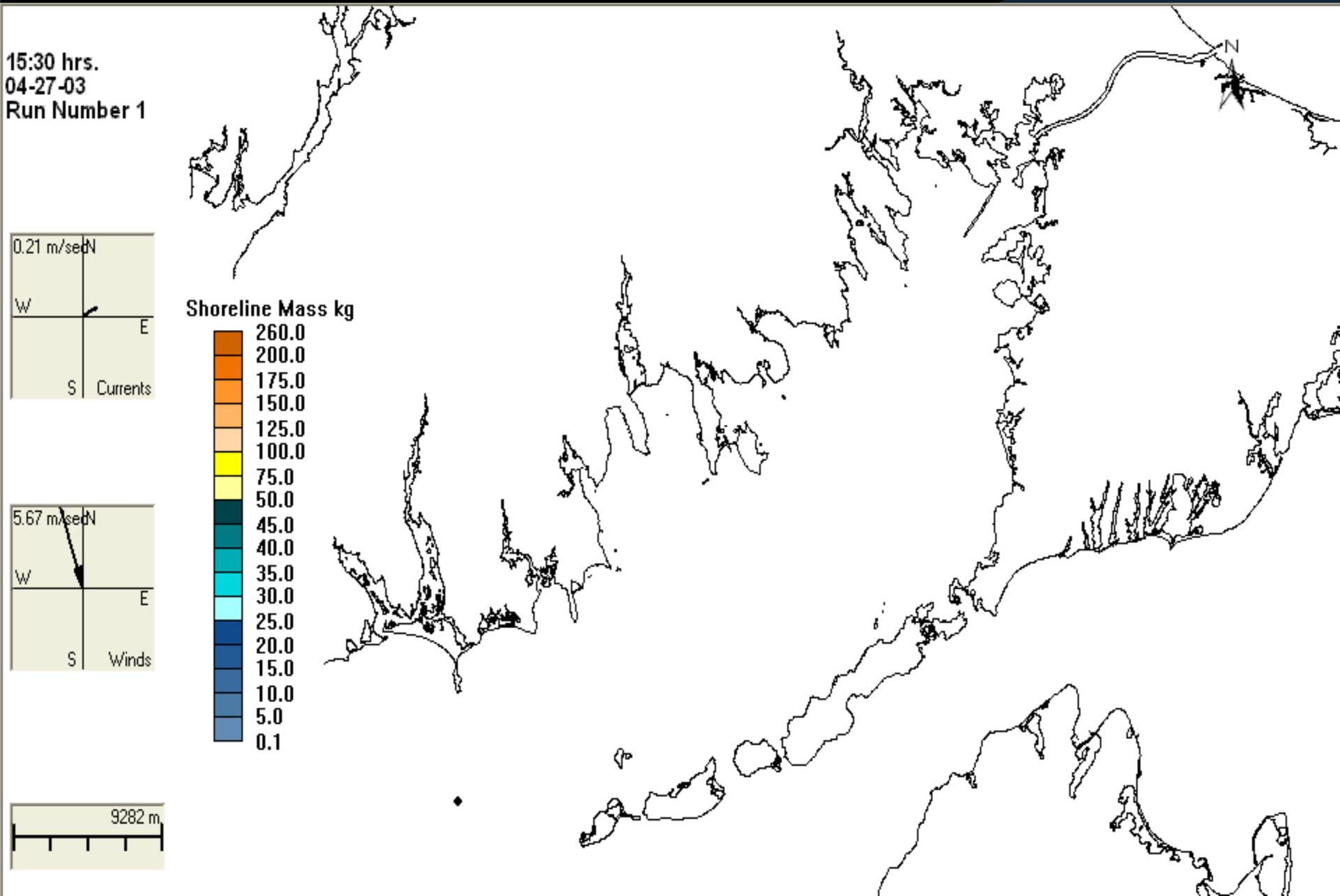
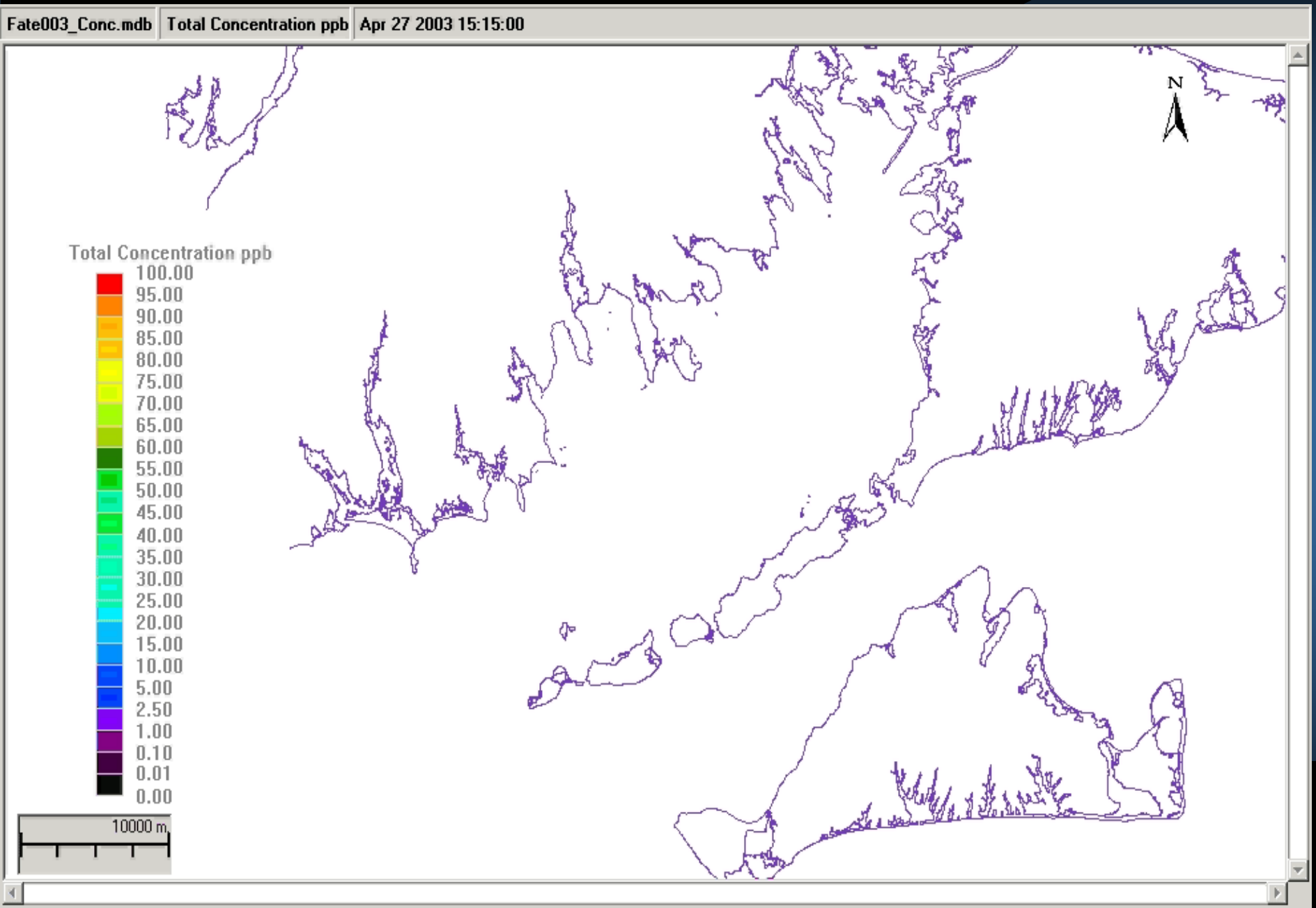
Surface Oil Movement



Dissolved Concentrations



Issues re: modeling

- Estimated mortality projected by models can not be proven
- Visual and field data may not comport with model estimates
- Input data incomplete or lacking
- Use of lab data for field predictions
- Results can be taken as the “final word”

Successful Use of TFE Models Involves:

- Collaboration: as early in the process as possible
  - ✓ Common data bases at start up
  - ✓ Interim calibrations and milestones,
  - ✓ Phased work plan
- Start Planning Early (field data for input and calibration)
  - ✓ Response phase: ideal
  - ✓ Injury assessment phase
- Parity and Transparency
  - ✓ Cooperative Assessments involve technical discussions between two sides
  - ✓ Comparable tools

Recognition of TFE Limitations

- Not necessarily the final word:
  - ✓ Data limitations for input
  - ✓ Significant uncertainties around output
  - ✓ No way to verify predicted mortalities
- Review and test projections with alternative assessment approaches
  - ✓ Field observations re: injury
  - ✓ Experiences from other assessments
  - ✓ Common sense

Wildlife Impacts

Birds

Mortality Estimation

- What is a bird multiplier?
  - ✓Take the number of bird carcasses collected and multiply by some number to adjust for
    - Sinking prior to reaching shore
    - Scavenging from shore prior to search
    - Burying prior to search
    - Deposited on unsearched/hard to search shoreline
    - Imperfect search – missing birds that are there
    - Background (baseline) deposition

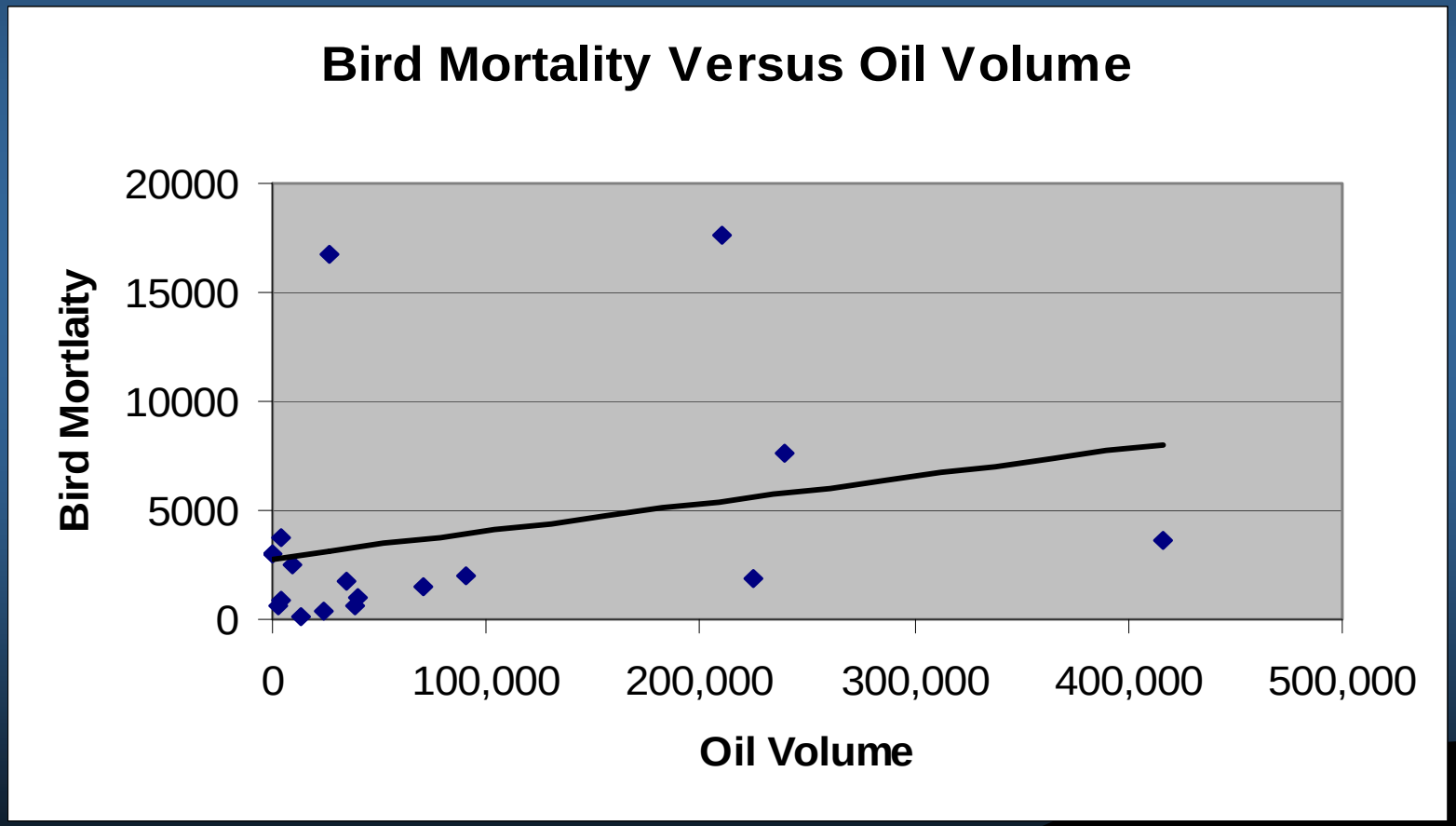
Mortality Estimation

There are 3 methods to estimate multipliers

1. Literature transfer
2. Swept through modeling
3. Beached Bird Modeling (BBM)

Literature Transfer

- Apply multiplier estimated for some other spill
  - ✓ Perhaps adjust for factors such as oil type, volume…



Literature Transfer

Minimal data requirements but:

"The data show the wide variance in mortality in spills of all sizes. A loose 'rule-of-thumb' that is often used in poorly documented spills is that the overall mortality is ten times the actual body count. There is no justification for this notion. The mean estimate is 4–5 times the body count, but each spill should be examined independently"

Burger 1993

Ford (no date) updates Burger analysis with more variables, but still finds low predictability overall

Swept Through Modeling

1. Hydrodynamic model “sweeps” oil across surface waters and shorelines
2. ID acres of habitat swept
3. Estimate birds “at risk” by assigning bird density to each habitat
4. Estimate birds “at risk” that get oiled
5. Apply mortality rate to oiled birds (uncertain)

Swept Through Modeling

- Intermediate data requirements but

  "For well studied spills where both field estimates of oiled birds and pre-spill abundances are well measured, the model and field estimates generally agree within a factor of 2 or 3."

  French-McCay and Rowe 2004

BBM

1. Convert carcass collections to deposition by adjusting for *search efficiency* and *scavenging*
2. Convert deposition into total carcass deposition by adjusting for *incomplete search*
3. Convert total carcass deposition into spill related deposition by adjusting for *background deposition*
4. Convert spill related deposition to spill related mortality by adjusting for *sinking*

Multiplier = spill-related mortality ÷ carcasses collected

Beached Bird Model Steps 1 & 2:

- 16 birds wash ashore
- 2 birds found
- Total deposition is 16

BBM

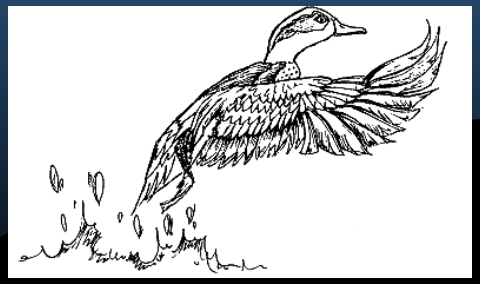
- Step 3: Total deposition to spill-related deposition
  - ✓ If one of the two carcass collections was background, total spill related deposition is 8
- Step 4: Spill-related deposition to spill mortality
  - ✓ If 10 percent of carcasses sank prior to being deposited on a shore, total spill-related mortality is about 9
- Step 5: Estimate the multiplier
  - ✓ Multiplier is 9 spill mortalities ÷ 2 collections = 4.5

BBM

- Preceding was very simple example
  - ✓In reality the shoreline is broken into many *search transects*
  - ✓Each transect is searched multiple times
  - ✓The multiplier for each search incorporates *holdovers*
  - ✓*Extrapolation* to unsearched areas is uncertain

Mortality Estimation: Summary

- BBM requires the most input data
- BBM likely associated with the highest transaction costs
- However, if *"wide variance"*, and *"accurate to within a factor of 2 or 3"* are not good enough, BBM may be the only viable method



Without Transparency …….

- Results suspect since only one side can “verify”
- Less understanding of parameter sensitivities
- Less true collaboration among parties